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Application No:	GB 0302553.3	**Examiner:**	A.R.Martin
Claims searched:	All claims	**Date of search:**	23 June 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	n/a	GB 1344520 Akiengesellschaft see claim 7

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

B3A,B3K,B3B

Worldwide search of patent documents classified in the following areas of the IPC[7]:

B21K

The following online and other databases have been used in the preparation of this search report:

On line databases WPI,EPODOC,JAPIO

1 344 520

PATENT SPECIFICATION

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(54) TURBINE WHEEL

(71) We, AKTIENGESELLSCHAFT KUHNLE, KOPP & KAUSCH, a body corporate organised under the laws of Germany of, 671 Frankenthal, 16 Friedrich-Ebert-Stra-e, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a turbine wheel and to a method of forming turbine wheels, in which a centering cone is formed at the front or exit side of the turbine wheel and is made up of a multi-faceted conical formation. By "exit side" we mean the side from which spent gases exit.

The present invention is particularly suited to the production of turbine wheels for centripetal turbines particularly for those used as waste gas turbochargers. It is known to produce such wheels from heat resistant materials and high quality castings. The present construction of such wheels does not pay much attention to the possibilities for weight reduction and the lessening of subsequent machining expenditure.

An object of the present invention is to provide a turbine wheel which can be produced with a minimum of material and machining expenditure in a high quality casting and which has operational advantages as well.

According to the present invention there is provided a turbine wheel for centripetal turbines, the wheel having been manufactured by investment casting in which a sprue formation is formed at the exit side of the cast wheel and is subsequently removed, the wheel comprising a hub portion with a plurality of radially extending blades, and a centering cone extending axially from the exit tip of the blades which cone forms the termination of the removed casting sprue formation, the centering cone including a multi-faceted surface for securing the exit side to a compressor wheel.

The invention also provides a method of forming a turbine wheel for a centripetal turbine, comprising casting the wheel from the exit end to form a sprue extending from a centering cone formation of an exit hub portion of the wheel, and thereafter removing the sprue from the exit end of the hub having the centering cone.

This means that no machining is necessary on the inside or rear side of the turbine wheel. The maximum diameter of the centering cone which is formed on the casting side or exit side is equal to the diameter of the hub of the wheel and the conical outer surface of the centering cone has recesses or flat faces which define a polyhedron or multi-toothed surface.

Thus in the method of the invention a turbine wheel is formed by casting the wheel to form the hub and blade by directing the metal into a sprue extending from the front or blade exit side and forming the opposite or rear side with an axially extending recess, thereafter severing the sprue at the exit side to leave a centering cone remaining which includes a multi-faceted annular conical formation.

The turbine wheel according to the invention is simple in design, rugged in construction, and economical to manufacture.

The invention is further described with reference to the accompanying drawings, in which:

Figure 1 is an axial sectional view of a known turbine wheel construction;

Figure 2 is a view similar to Fig. 1 or a turbine wheel constructed in accordance with the invention;

Figure 3 is a partial end elevation view of the turbine wheel shown in Fig. 2; and

Figure 4 is a partial enlarged axial sectional view of the turbine wheel shown in Fig. 2.

[Price 25p]

The prior art construction shown in Fig. 1, includes a turbine wheel having a hub portion 1 with a plurality of radially extending blades 10. The casting of the wheel is effected from the stump 2 shown in dotted lines at the rear side of the turbine wheel. When the known casting methods are used, this rear side must be machined along with the edges of the blades 10 as indicated by the broken lines. On the front side of the turbine wheel which is referred to as the exit side of the wheel, there is provided a centering cone 3. The centering cone 3 is chucked for machining the rear side and material is subsequently ground off from the centering cone to balance the wheel. A multi-faceted extension 4 is cast on the exit side. The facets preferably define a multi-toothed shape, for example one having twelve teeth. When the compressor wheel is arranged on the shaft, which is welded on the turbine wheel, this extension serves to retain the wheel to prevent it from turning.

The turbine wheel is, in accordance with the invention, shown in Figs, 2, 3, and 4, produced from a high quality casting which is carried out from the front side of the wheel. For this purpose, a sprue extension 9 is formed which is severed from the casting at the point 16. Thus, in this construction, the part 4 which is required in the prior art shown in Fig. 1, is not necessary. This means that a particularly unfavourable weight at a large distance from the bearing is eliminated. The multi-faceted extension for holding the wheel in the assembly is formed integrally with a conical end part 7. This conical end part 7 also serves as a centering cone. Its maximum diameter is equal to the diameter of the hub of the wheel on the exit side. The diameter of the sprue 9 is equal to the minimum diameter of the cone.

As shown in Fig. 3, the conical part 7 comprises a twelve-toothed extension 8 which is formed as a twelve pointed star. The faces of the teeth extend in planes parallel to the axis of rotation, and are tapered toward the outside to the right as shown in Fig. 4. These flattened triangular faces provide an engagement end for affixing a tool thereto to prevent rotation for centering.

Material can be removed from the cone 7 on the exit side of the wheel in order to balance the rotor. This removal has to be effected over an angular range which is substantially less than 180 degrees. For this reason, there is always sufficient material of the extension 8 left so that the tool is still effective.

Since the wheel is cast from the front side, the rear side can be cast without the necessity of subsequent machining. A small surface for welding 11 can be ground off. Casting from the front side permits the formation of an inner recess 12 whose size depends on the expected operational stress of the wheel. This can extend up to the front side, for example, up to a point 13, or at a higher stress, up to a point 14.

With higher waste gas temperatures, for example, in gasoline engines, it was found advantageous to make the recess between 25% and 90% of the axial maximum extension of the wheel. This not only reduces the mass of the wheel considerably but has an additional advantage in that less heat is generated in the bearings of the turbocharger when it is stopped due to the reduction of the mass of the heated wheel. This means that there is less tendency for overheating and coking of the bearing to take place and there is less tendency for the sealing ring 15 to be burned out on the turbine side. Higher operating temperatures of the wheel, as are required for example in gasoline engines or high powered engines, are thus possible without endangering the life of the sealing ring 15.

It has been found that the wheel constructed in accordance with the invention permits savings of material of from 20 to 25% of the weight of the blank. By changing the machining it is possible to manage with one chucking operation and one machining operation compared to the previously required five operations. The machining time is reduced from 17.5 minutes to 0.8 minutes. In addition, the new wheel form permits higher operating temperatures without reducing the life of the bearing and gasket.

WHAT WE CLAIM IS:—

1. A turbine wheel for centripetal turbines, the wheel having been manufactured by investment casting in which a sprue formation is formed at the exit side of the cast wheel and is subsequently removed, the wheel comprising a hub portion with a plurality of radially extending blades, and a centering cone extending axially from the exit tip of the blades which cone forms the termination of the removed casting sprue formation, the centering cone including a multi-faceted surface for securing the exit side to a compressor wheel.

2. A turbine wheel according to claim 1, wherein the said surface defines a twelve-toothed formation.

3. A turbine wheel according to claim 1 or 2, wherein the centering cone has portions removed by machining, whereby the turbine wheel is balanced.

4. A turbine wheel according to any preceding claim, wherein the rear side of the hub portion is formed with a recess having a length of from 25 to 90% of the

entire axial extension of the turbine wheel.

5. A turbine wheel according to any preceding claim, wherein the said multi-faceted surface is star-shaped in cross-section and extends from the exit tip of the blades in an axial direction and being tapered inwardly.

6. A turbine wheel substantially as herein described with reference to Figures 2 to 4 of the accompanying drawings.

7. A method of forming a turbine wheel for a centripetal turbine, comprising casting the wheel from the exit end to form a sprue extending from a centering cone formation of an exit hub portion of the wheel, and thereafter removing the sprue from the exit end of the hub having the centering cone.

8. A method according to claim 7, comprising the further step of machining the centering cone to remove portions thereof to balance the wheel.

9. A method according to claim 7 or 8, including forming a recess on the rear end of the hub portion to a connecting shaft.

10. A method of forming a turbine wheel substantially as herein described with reference to Figures 2 to 4 of the accompanying drawings.

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1344520 COMPLETE SPECIFICATION

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FIG. 1

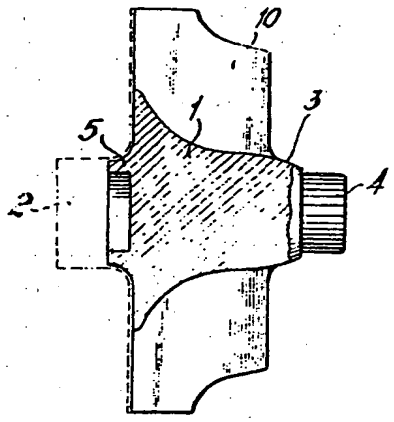

FIG. 2

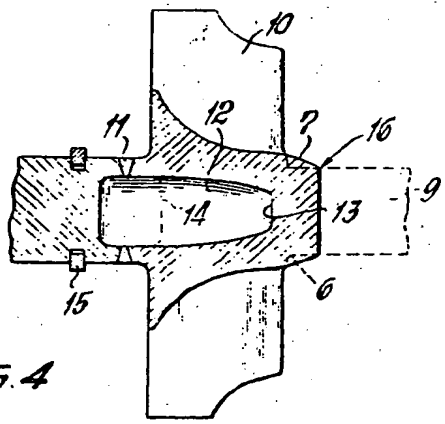

FIG. 3

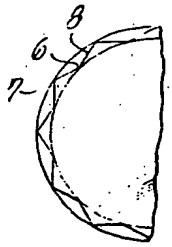

FIG. 4